MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

EEE1036 – DIGITAL LOGIC DESIGN

(All sections / Groups)

9 AUGUST 2022
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **SEVEN** pages including cover page with **FOUR** questions only.

2. Answer **ALL** questions and print all your answers in the answer booklet provided.

3. All questions carry equal marks and the distribution of the marks for each question is given.

Question 1

(a) Give three (3) advantages of digital systems over analog systems.

[6 marks]

(b) Convert the given numbers in Table Q1 to other specified bases listed. (Note: Show your working)

Table Q1

Base	Binary	Octal	Decimal	Hexadecimal
Number		244		
	0.111			0.E

[10 marks]

(c) Perform the following operation in 2's complement system by using 8 bits (including the sign bit) for each number. Check your results by converting the binary result to decimal. (Note: Show your working)

(i) 84_{16} minus AA_{16}. Is there an overflow condition? Why?

[6 marks]

(d) Perform the following operations: (Note: Show your working)

(i) Convert the BCD number 00010101 to decimal.
(ii) Convert binary number 1001110110 to Gray code.

[3 marks]

Continued...

Question 2

(a) Given the following logic function:

$$f(A,B,C,D) = \Sigma m(1, 2, 4, 8, 10, 14) + d(6, 7, 11)$$

Find the minimum SOP expression using Quine-McCluskey method.

[10 marks]

(b) Simplify the given expression below to a SOP form using Boolean theorems.

$$Y = \overline{\overline{(\overline{A}C + \overline{B}\overline{D})}\,(AC + D)} + \overline{A}\,\overline{B}\,(C + D)$$

[6 marks]

(c) Simplify the given expression below to a SOP form using Karnaugh Map.
$f(A,B,C,D) = \Sigma m(0, 2, 4, 8, 10, 14) + d(6, 7)$

[7 marks]

(d) For the given expression below, convert its maxterm expansion to its minterm expansion.
$F(A, B, C) = \prod M\,(1,3,4,5)$

[2 marks]

Continued...

Question 3

(a) Flip-flop changes state when a signal is applied to its inputs, triggered by clock signal. Redraw the given clock for a positive edge-triggered of S-R flip-flop as shown in Fig. Q3(a). Complete the Q output waveform in response to the positive edge-triggered flip-flop. Assume the initial condition for Q is low.

[3 marks]

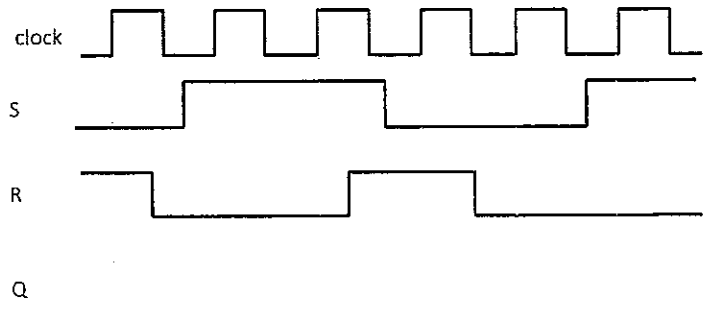

Fig. Q3(a)

(b) The waveforms as shown in Fig. Q3(b) are applied to the negative-edged triggered J-K flip-flop's inputs: J, K and clock inputs. Draw the timing diagram of the clock and complete the signals, Q and Q' in Fig. Q3(b). Assume that the flip-flop is initially RESET (Q = 0). [6 marks]

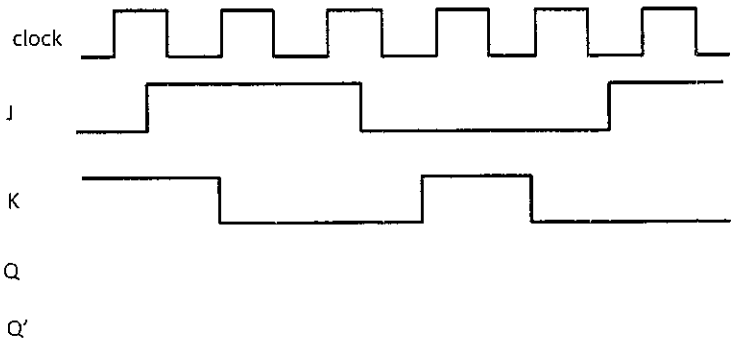

Fig. Q3(b)

Continued...

(c) A synchronous counter using negative-edge triggered T flip-flops has the following counting sequence:

0, 1, 3, 4, 7, 0, 1... repeats.

(i) Develop a next state table for the counter sequence. [7 marks]

(ii) Produce Karnaugh maps and logic expressions for the flip-flop inputs for a three-bit counter using T flip-flops transition truth table. [9 marks]

Continued...

Question 4

(a) Implement the function, $F(A,B,C) = \sum m(2,3,5,7)$ using only a single 3-to-8 decoder and standard logic gates as stated below:

(i) a decoder with active high outputs and an OR gate [6 marks]

(ii) a decoder with active low outputs and a NAND gate [7 marks]

(b) Design a circuit using a 1-to-8 demultiplexer with active low outputs and logic gates, such that it has the following functions:

(i) $f_1(A,B,C) = \sum m(1,2,6,7)$ [6 marks]

(ii) $f_2(A,B,C) = (A + \bar{B} + \bar{C}).(A + B + C).(\bar{A} + \bar{B} + C)$ [6 marks]

Continued...

APPENDIX

Selected Laws of Boolean Algebra

1. Commutative Law
   (a) $A + B = B + A$
   (b) (b) $A\,B = B\,A$
2. Associate Law
   (a) $(A + B) + C = A + (B + C)$
   (b) (b) $(A\,B)\,C = A\,(B\,C)$
3. Distributive Law
   (a) $A\,(B + C) = A\,B + A\,C$
   (b) (b) $A + (B\,C) = (A + B)\,(A + C)$
4. Identity Law
   (a) $A + A = A$
   (b) (b) $A\,A = A$
5.
   (a) $A\bar{B} + A\bar{B} = A$
   (b) (b) $(A+B)(A+\bar{B}) = A$
6. Redundance Law
   (a) $A + A\,B = A$
   (b) (b) $A\,(A + B) = A$
7.
   (a) $0 + A = A$
   (b) (b) $0\,A = 0$
8.
   (a) $1 + A = 1$
   (b) (b) $1\,A = A$
9.
   (a) $\bar{A} + A = 1$
   (b) (b) $\bar{A}\,A = 0$
10.
    (a) $A + \bar{A}\,B = A + B$
    (b) (b) $A\,(\bar{A} + B) = A\,B$
11. De Morgan's Theorem
    (a) $\overline{(A + B)} = \bar{A}\ \bar{B}$
    (b) $\overline{(A\,B)} = \bar{A} + \bar{B}$

End of Paper